For release Wednesday 7 June 1995.
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TRANSCOPYRIGHT PERMISSION:
THE SYSTEM FOR UNRESTRICTED REPUBLICATION

LOS ANGELES, 7 June 1995. Ted Nelson, founder of Project Xanadu, today proposed "transcopyright"as a new linguistic and legal convention. It is intended to encapsulate a permission system in a word and symbol, like the term "shareware" (coined by Bob Wallace). "If, like the term 'shareware,' it enters the language and understanding of business, it should benefit everyone who chooses to participate, providing both potential revenue and intellectual credit. It is a method which will work with text, graphics, audio, video, and three-dimensional models," said Nelson.

The announcement was made at a press conference in Los Angeles today. "My work has always been about being able to re-use digital materials and deeply intercompare them in hypermedia formats," said Nelson. His intention has been to create a world of ***unified transmedia***, where everyone's materials can be shared and republished as boilerplate and clip art, but with automatic royalty to the owners of the contents, and where users can compare the re-uses with the original contexts. These have always been goals of Project Xanadu. But these are not merely technical issues; these goals have always implicitly relied upon a copyright method which has not been separately explained.

The proposed copyright method is actually a very simple idea, but it has been bound up with the controversial Project Xanadu, which many people have not understood. " I had actually not recognized that the copyright method could be neatly separated from the delivery software we designed at Project Xanadu," admitted Nelson.

The anarchic hypertext publishing universe, which Nelson envisioned decades ago, now exists. It is not called Xanadu but World Wide Web, and its growth and impact have so far followed the course whch Nelson had projected for Xanadu. The Web adopted several important parts of the Xanadu model, including the neutral-service back end and highly-capable browsing client, e.g. Mosaic and Netscape. "Now I want to see the remaining part of my ideas come to fruition," said Nelson.

"A key aspect will be the unrestricted re-use and republication of material, and that's what this copyright scheme addresses," Nelson explained. "But until recently, I had actually not recognized that our copyright method could be neatly separated from the delivery software we designed at Project Xanadu."

The copyright system, separable from any technicalities, may be used by rightsholders through any delivery system they choose. The system allows anyone to purchase and keep legal copies of whatever digital materials they want. If widely used, it will create a universe of readily-available materials which may be recomposited by all users for all purposes.

"Furthermore, it *works within the present system of law*," Nelson added.

"It doesn't even require a contract. It is a specific permission system, allowing everyone to quote material virtually and in any context, ***providing that each copy of the materials is purchased from the rightsholder***. As a permission doctrine it resembles "shareware," which is also a permission doctrine encapsulated in a word that everyone understands."

"My objective right now is to establish a name and definition for this permission doctrine so that everyone who chooses may use it freely and to everyone's benefit," said Nelson. "I believe that this method represents a unique solution to the issue of digital copyright that is win-win, honest, fair, voluntary, subject to local variations as required, interoperable among variations, and transitive (you may republish something you receive from someone else).

The term Nelson has proposed is "transcopyright." It is not a trademark but a ***declaration of permission to re-use in specific ways***, and it can be symbolized as follows:

trans© 1995 Bill Gates

or, in alternative styles,

trans(c) 1995 John Draper
transcopyright © 1995 Gary Wolf
transcopyright (c) 1995 Steve Jobs

It will be noted that the conventional copyright declaration is fully contained within the transcopyright declaration and therefore operative.

Nelson proposed the following definition for this declaration, adding that "the wording will no doubt improve with time."

> **"I (we) claim to be the rightsholder of this material. I (we) hereby give permission for the virtual re-use of this material for sale to any party for use in any new on-line context, provided that the virtual re-use consists only of providing a pointer or address to my network source for this material; and an indication of where this material is to be placed in the final recipient's copy of the digital document or object. I specifically relinquish context control over such new contexts if the material is purchased from my designated source by the end user. The end user may make one printout or other portable copy, and may in turn republish this material virtually in the same manner. I relinquish no other rights."**

Specific variations of the arrangement may be decreed in the different jurisdictions by whoever runs them, provided that the above definition is understood as central.

ADDITIONAL ASPECTS OF THE METHOD

Transcopyright may best be understood as a way to eliminate negotiation between rightsholders and republishers across a broad class of direct quotation (but not adaptation or conversion of materials). Actual conversion of the elements to other forms would have to be an issue for separate permission, unless each purchaser can separately perform the conversion after purchasing the materials, possibly under the republisher's instructions for assembly of the intended object.

"Note that this system only works for on-line delivery," Nelson pointed out. " It does not transpose to hardcopy arrangements, CD-ROMs, etc., where print runs, production runs, intended marketing, etc. are relevant to licensing the use of material. These require specific negotiation with, and permission from, the rightsholder."

"Transcopyright permission has two special advantages: it legitimizes repurposing and republication to be legally undertaken by anyone; and it provides an honest method for such repurposing and republication that all can readily agree is honest. Thus, for instance, any corporation wishing to obey the law can direct all its employees to obey transcopyright provisions with the knowledge that they can still repurpose the materials in any way useful to the firm. And records may be kept to document these legitimate purchases.

Transcopyright permission only works where the bytes are not re-transmitted by the republisher, but always bought anew by each user from the original publisher (or the rightsholder, or the rightsholder's sales agent). However, conversion of the bytes opens so many issues for rightsholders that such a simple method is probably impossible. If the republisher wishes to convert the bytes to a new form and retransmit them as part of a package, some other kind of permission must be arranged.

"This leads to some interesting edge cases," said Nelson. "Transcopyright can be used for sound samples to be loaded into MIDI systems for musical play, but not for delivery of musical recordings incorporating others' copyrighted sound samples. Similarly, three-dimensional models and puppets may be purchased in this way, but using these three-dimensional puppets in film or video productions would require additional permission from the rightsholder. But if each customer buys the music sample and independently combines it with the musical score, as directed by the republisher, or or independently buys the 3D puppet and combines it with the animation, as directed by the republisher, it fits within the model of independent purchase and legitimately works with transcopyright."

Nelson does not expect large conventional publishers to be interested in this method at first, but foresees its immediate appeal to small publishers. There are perhaps forty major publishing firms in the United States, and some seventy-five thousand publishing firms altogether. " The immediate market is therefore about 75,000-minus-forty firms in the U.S.A., and many more abroad," said Nelson.

SPECIAL CASE OF MUSIC

Nelson pointed out that the plan cannot work with the standard ASCAP/BMI model as currently constituted, which grants "synchronization rights" only by specific negotiation with each party creating a film or comparable work. "Pragmatically, I think this means that transcopyright will enter the music business via 'unsigned bands' who are not subject to ASCAP/BMI rules."

SITE LICENSING

This model works perfectly when individual end-users are the market. "But," Nelson added, "if companies, universities, clubs, etc., wish to keep copies for distribution to their membership, it becomes slightly sticky. The best solution within this model, as I see it, is a kind of actuarial arrangement (as with corporate insurance), where the firm submits facts about the organization and is granted a license on some statistical basis of payment (like an insurance rate). But note that each transcopyright jurisidiction can set its own rules in these areas."

SPECIFICATION OF SOURCE, SALES AGENT, JURISDICTION

"In addition to the transcopyright notice, the declaration should also designate the source, jurisdiction or sales agent from which the material may be obtained," Nelson explained. This can be a courtesy to those who wish to purchase or republish, and also an indication as to where the prices, rules, by-laws and variations of that particular transcopyright system are defined. Examples:

transcopyright © 1995 John Smith, Compu-Serve
Trans(c) 1995 John Smith, Kinko's.
Transc© 1995 John Smith, Xanadu.
trans(c) 1995 John Smith, agent to be announced

The last case indicates an intention to grant transcopyright permission on the material, but no definite place to obtain the material as yet.

TECHNICAL REQUIREMENTS

This requires nothing heavy-duty. **SERVER SIDE, BUSINESS:** it requires this permission by all rightsholders, a committed repository in which the material is guaranteed to remain, unchanged. **SERVER SIDE, TECHNICAL:** it requires server software capable of selling the material in small arbitrary portions for micro-amounts, with receipt. (Note that conventional book royalties are in the range of 4000 nanobucks per byte, videotape profits are in the range of 18000 nanobucks per frame.) **CLIENT SIDE:** requires extensions to Mosaic, Netscape, etc., for such purchase, recompositing and filing of this material.

ENFORCEMENT

This system is no more enforceable, and no less enforceable, than any other digital copyright scheme.

XANADU'S FUTURE PLANS

After a long and what some have characterized as a painful history, Project Xanadu is in the process of redefinition. This will include setting specifications for Xanadu-like virtual documents and functions, which any developers may implement as they please. The company has plans to license some software systems which meet these specifications to be marketed under the name "Xanadu." Agreements are already underway or in development with Information Farm, Inc. of Berkeley, CA; Xanadu Australia of Melbourne, Australia; and Sensemedia of Santa Cruz, CA. An early goal of this effort will be to establish Xanadu® Quotable Repositories, which will offer material for small-portion sale under transcopyright, using the trademark "Quantum Quotation™."

"Establishment of Transcopyright as part of the legal landscape is a vital first step in this direction," Nelson concluded.

Project Xanadu is located at 3020 Bridgeway, Suite 295, Sausalito CA 94965; their telephone number is 415/ 331-4422, and their fax number is 415/ 332-0136. Nelson also holds the position of Research Fellow at the Sapporo HyperLab, Sapporo, Japan, and Editor at Large for NewMedia magazine, San Mateo, California. "Xanadu" is a registered trademark of Project Xanadu.

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TED NELSON BIO

Ted Nelson is well known as a basic thinker in interactive media. Nelson is best known as the founder of Project Xanadu, of which he resumed control in 1992, after nine years of uneasy development by others. Nelson is now once again the holder of the Xanadu trademark, which he coined in 1967. An early prophet of personal computing, he coined the terms "hypertext" and "hypermedia" in 1965. However, his initial vision in the fall of 1960 covered a much broader range: human work at computer screens, a world of personal computers and interactive software, and a future of all-digital media delivered from a network of servers around the globe-- ***with automatic royalty and copyright maintained, but everyone free to quote everyone else's material without impediment, and everyone able to see the original context of each thing quoted***. Those who think his ideas have all come true do not understand his ideas.

Nelson's concept of world-wide anarchic hypertext publishing-- put forth in his numerous articles and lectures, and his books *Computer Lib* and *Literary Machines*-- has entered public consciousness with the mainstream success of World Wide Web and Mosaic, both based on his ideas as expressed in *Literary Machines*. But his fundamental ideas of transclusion and universal transmedia-- universally quotable hypermedia that anyone can use as clip art and compare in parallel contexts-- have not yet been implemented. It is as a step toward such universal transmedia that he is now introducing the "transcopyright" concept.

Unlike many software and hardware developers, Nelson's background did not focus on the technical. From childhood he was deeply absorbed in philosophical musings. However, with close relatives in the theater, he had early experience on the professional stage and in the first days of live television. At college he produced the first rock musical, an LP, and a movie, for which the music was written by Peter Schickele (better known in recent years as P.D.Q. Bach). He received his bachelor's in philosophy from Swarthmore College in 1959. He pursued additional studies at the University of Chicago for a year, then entered an interdisciplinary program in the social sciences at Harvard, where he obtained a master's degree in sociology in 1962.

It was in that Harvard program, in the fall of 1960, that he took the computer course which united his interests in philosophy with his interests in show business and cinema, giving him a "stereoscopic" view of future media. He envisioned the computer as both "philosophy equipment," dealing with arbitrary abstractions of any kind, and also "a new kind of movie machine," able to present new experiences at its interactive screen. This meant ***the central problem was designing the right abstractions for the new computer media***. In the fall of 1960 he set out to build the system for delivery of digital media from computer networks, later to be named Project Xanadu.

Throughout a varied career dodging toward this goal, he has been a dolphin photographer for Dr. John Lilly, instructor in sociology at Vassar College, assistant to president William Jovanovich at Harcourt, Brace & World, hypertext consultant to Bell Laboratories, editor of *Creative Computing* magazine, lead designer for office software at Datapoint Corporation (San Antonio), and Distinguished Fellow at Autodesk, Inc. He is now Research Fellow at Sapporo HyperLab in Sapporo, Japan, as well as Editor at Large for NewMedia magazine and director of the new Project Xanadu. In his wide academic experience he has taught in departments of art, anthropology, architecture, computer science, economics, information science, instructional resources development and mathematics, at such institutions as Vassar College, Swarthmore College, the University of Illinois, and most recently the University of Strathclyde in Glasgow, Scotland, where he held the rank of Visiting Professor.

He currently divides his time between homes and offices in Sausalito, California and Sapporo, which he shares with his partner Marlene Mallicoat.

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e-mail ted@xanadu.net

"Xanadu" is a registered trademark of Project Xanadu.

TRANSCOPYRIGHT PERMISSION:

How We Can Have Unrestricted Re-Publication of Digital Media with Fair Payment and Royalty

WHAT I AM ANNOUNCING. "Transcopyright" is a proposed linguistic and legal convention, intended to encapsulate a permission system in a word and symbol, like the term "shareware" (coined by Bob Wallace). If, like the term "shareware," it enters the language and understanding of business, it should benefit everyone who chooses to participate, providing both potential revenue and intellectual credit. It is a method which will work with text, graphics, audio, video, and three-dimensional models.

My work has always been about being able to re-use digital materials and deeply intercompare them in hypermedia formats. My intention has been to create a world of ***unified transmedia***, where everyone's materials can be shared and republished as boilerplate and clip art, but with automatic royalty to the owners of the contents, and intercomparable betweeen the re-uses and the original contexts. These have always been goals of Project Xanadu. But rather than being technical issues, these goals have always implicitly relied upon a copyright method which has not been separately explained.

The proposed copyright method is actually a very simple idea, but it has been bound up with the controversial Project Xanadu, which many people have not understood or wanted to understand. Many people have failed to hear what I actually said, hearing my predictions about world-wide anarchic hypertext publishing, but not the details I was actually concerned about. I had actually not recognized that the copyright method could be neatly separated from the delivery software we designed at Project Xanadu.

We now have world-wide anarchic hypertext publishing, called not Xanadu but World Wide Web, and its growth and impact have pretty well tracked what I thought would happen with Xanadu. The Web adopted several important parts of the Xanadu model, including the neutral-service back end and the highly capable browsing client (Mosaic and Netscape). Now I want to see the remaining part of the idea come about. I had actually not recognized that the copyright method

could be neatly separated from the delivery software we designed at Project Xanadu.

The copyright system turns out to be actually quite separable from the technicalities, and may be used by anyone with any delivery system they choose. The system allows anyone to purchase and keep legal copies of whatever they want. If used by many rightsholders, it will create a universe of readily-available materials which may be recomposited by all users for all purposes.

Furthermore, it *works within the present system of law.*

It does not even require a contract. It is a specific permission system, allowing everyone to quote material virtually and in any context, ***providing that the the materials are purchased from the owner***. Thus it resembles "shareware," which is also a permission doctrine. My objective right now is to establish a name and definition for this permission doctrine so that everyone who chooses may use it freely and to everyone's benefit.

I believe that this method represents a unique solution to the issue of digital copyright that is **•WIN-WIN, •HONEST, •FAIR, • VOLUNTARY, •LOW-HASSLE, •PROVABLE, •SUBJECT TO LOCAL VARIATIONS AS REQUIRED, •INTEROPERABLE AMONG VARIATIONS**, and **•TRANSITIVE** (you may republish something you receive from someone else).

The name I propose for this is "transcopyright" (not a trademark) It is a ***declaration of permission to re-use in specific ways***. I proposed that it be symbolized as follows:

trans© 1995 John Smith

or, alternatively

trans(c) 1995 John Smith
transcopyright © 1995 John Smith
transcopyright (c) 1995 John Smith

It will be noted that the conventional copyright declaration is fully contained within the transcopyright declaration and therefore operative.

I propose the following definition for this declaration. (The wording will no doubt improve with time.)

"I (we) claim to be the rightsholder of this material. I (we) hereby give permission for the virtual re-use of this material for sale to any party for use in any new on-line context, provided that the virtual re-use consists only of providing a pointer or address to my designated sales agent, archive site or network source for this material; and an indication of where this material is to be placed in the final recipient's copy of the digital document or object. I specifically relinquish context control over such new contexts if the material is purchased from my designated source by the end user. The end user may make one printout or other portable copy, and may in turn republish this material virtually in the same manner. I relinquish no other rights."

Specific variations of the arrangement may be decreed in the different jurisdictions by whoever runs them, provided that the above definition is understood as central.

ADDITIONAL ASPECTS OF THE METHOD

Transcopyright may best be understood as a way to eliminate negotiation between rightsholders and republishers across a broad class of direct quotation (but not adaptation or conversion of materials). Actual conversion of the elements to other forms would have to be an issue for separate permission,unless each purchaser can separately perform the conversion after purchasing the materials, possibly under the republisher's instructions for assembly of the intended object.

Note that this system ONLY WORKS FOR ON-LINE DELIVERY. It does not transpose to hardcopy arrangements, CD-ROMs, etc., where print runs, production runs, intended marketing, etc. are relevant to licensing the use of material. These require specific negotiation with, and permission from, the rightsholder.

Transcopyright permission has two special advantages: it legitimizes repurposing and republicatio to be legally undertaken by anyone; and it provides an honest method for such repurposing and republication that all can readily agree is honest. Thus, for instance, any corporation wishing to obey the law can direct all its employees to obey transcopyright provisions with the knowledge that they can still repurpose the materials in any way useful to the firm. And records may be kept to document these legitimate purchases.

Note that transcopyright only works where THE BYTES ARE NOT RE-TRANSMITTED BY THE REPUBLISHER, BUT ALWAYS BOUGHT ANEW BY EACH USER FROM THE ORIGINAL PUBLISHER (or the rightsholder, or the rightsholder's sales agent). However, conversion of the bytes opens so many issues for rightsholders that such a simple method is probably impossible. If the republisher wishes to convert the bytes to a new form and retransmit them as part of a package, some other kind of permission must be arranged.

This leads to some interesting edge cases. Transcopyright can be used for sound samples to be loaded into MIDI systems for musical play, but not for delivery of music al recordings incorporating others' copyrighted sound samples. Similarly, three-dimensional models and puppets may be purchased in this way, but using these three-dimensional puppets in film or video productions would require additional permission from the rightsholder. But if each customer buys the music sample and independently combines it with the musical score, as directed by the republisher, or or independently buys the 3D puppet and combines it with the animation, as directed by the republisher, itfits within the model of independent purchase and legitimately works with transcopyright.

I do not expect large conventional publishers to be interested in this method at first. I expect it to have immediate appeal to small publishers. I think of it this way: there are perhaps 40 major publishing firms in the United States, and some 75,000 publishing firms altogether, most of them individuals and mom-and-pop operations. The immediate market is therefore about 75,000-minus-forty firms in the U.S.A., and many more abroad.

SPECIAL CASE OF MUSIC. Note that this plan cannot work with the standard ASCAP/BMI model as I understand it, which grants "synchronization rights" only by specific negotiation with each party creating a film or comparable work. Pragmatically, I think this means that transcopyright will enter the music business via "unsigned bands" who are not

subject to ASCAP/BMI rules.

SITE LICENSING. This model works perfectly when individual end-users are the market. If companies, universities, clubs, etc., wish to keep copies for distribution to their membership, it becomes slightly sticky. The best solution within this model, as I see it, is a kind of actuarial arrangement (as with corporate insurance), where the firm submits facts about the organization and is granted a license on some statistical basis of payment (like an insurance rate). But note that each transcopyright jurisidiction can set its own rules in these areas.

SPECIFICATION OF SOURCE, SALES AGENT, JURISDICTION, etc. In addition to the transcopyright notice, the declaration should also designate the source, jurisdiction or sales agent from which the material may be obtained. This can be a courtesy to those who wish to purchase or republish, and also an indication as to where the prices, rules, by-laws and variations of that particular transcopyright system are defined. Examples:

transcopyright © 1995 Metro-Goldwyn Mayer, source http://classics@lion.com
Trans(c) 1995 T. Nelson, Xanadu
Transc© 1995 John Smith, sales by Kinko's
trans(c) 1995 T. Nelson, agent to be announced

The last case indicates an intention to grant transcopyright permission on the material, but no definite place to obtain the material as yet.

TECHNICAL REQUIREMENTS. This requires nothing heavy-duty. **SERVER SIDE, BUSINESS:** it requires this permission by all rightsholders, a committed repository in which the material is guaranteed to remain, unchanged. **SERVER SIDE, TECHNICAL:** it requires server software capable of selling the material in small arbitrary portions for micro-amounts, with receipt. (Note that conventional book royalties are in the range of 4000 nanobucks per byte, videotape profits are in the range of 18000 nanobucks per frame.) **CLIENT SIDE:** requires extensions to Mosaic, Netscape, etc., for such purchase, recompositing and filing of this material.

ENFORCEMENT

This system is no more enforceable, and no less enforceable, than any other digital copyright scheme.

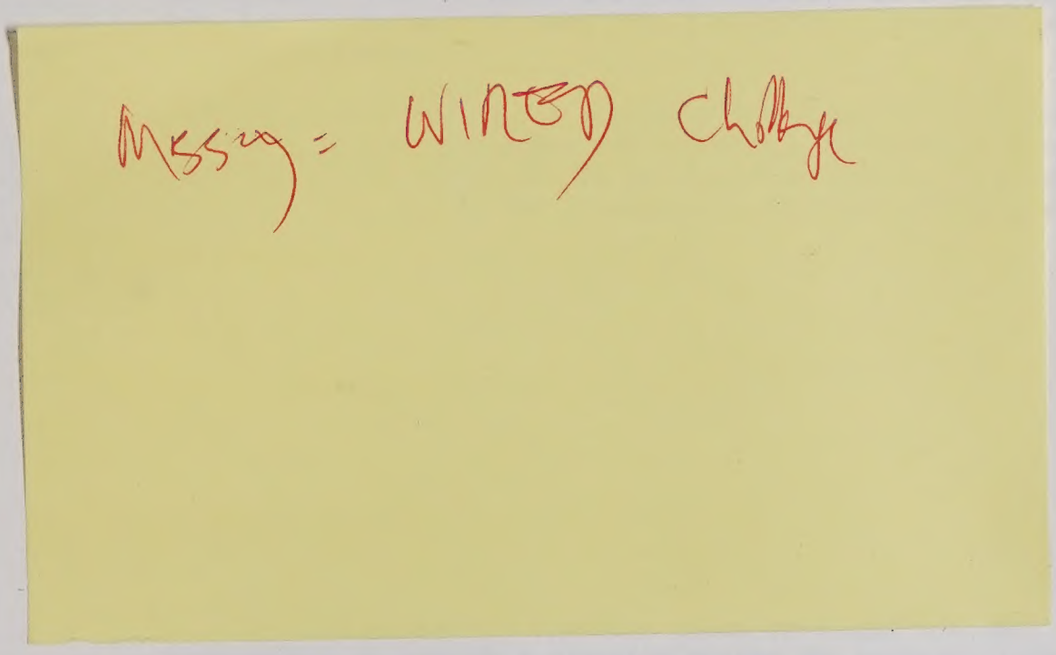
RELATION TO THE XANADU PROJECT. After a long and painful history, Project Xanadu is in the process of redefinition. This will include setting specifications for Xanadu-like virtual documents and functions, which anyone may obviously implement as they please. However, we plan to license some software systems which meet these specifications to be marketed under the name "Xanadu." Agreements are already underway or in development with Information Farm, Inc. of Berkeley, CA; Xanadu Australia of Melbourne, Australia; and Sensemedia of Santa Cruz, CA.

An early goal of this effort will be to establish Xanadu® Quotable Repositories, which will offer material for small-portion sale under transcopyright, using the tradmark "Quantum Quotation™."

Establishment of Transcopyright as part of the legal landscape is a vital first step in this direction.

A File Structure for The Complex, The Changing and the Indeterminate

Theodor H. Nelson
Vassar College, Poughkeepsie, N.Y. 12601



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Minor corrections by the author.

SUMMARY

THE KINDS OF FILE structures required if we are to use the computer for personal files and as an adjunct to creativity are wholly different in character from those customary in business and scientific data processing. They need to provide the capacity for intricate and idiosyncratic arrangements, total modifiability, undecided alternatives, and thorough internal documentation.

The original idea was to make a file for writers and scientists, much like the personal side of Bush's Memex, that would do the things such people need with the richness they would want. But there are so many possible specific functions that the mind reels. These uses and considerations become so complex that the only answer is a simple and generalized building-block structure, user-oriented and wholly general-purpose.

The resulting file structure is explained and examples of its use are given. It bears generic similarities to list-processing systems but is slower and bigger. It employs zippered lists plus certain facilities for modification and spin-off of variations. This is technically accomplished by index manipulation and text patching, but to the user it acts like a multifarious, polymorphic, many-dimensional, infinite blackboard.

The ramifications of this approach extend well beyond its original concerns, into such places as information retrieval and library science, motion pictures and the programming craft; for it is almost everywhere necessary to deal with deep structural changes in the arrangements of ideas and things.

I want to explain how some ideas developed and what they are. The original problem was to specify a computer system for personal information retrieval and documentation, able to do some rather complicated things in clear and simple ways. The investigation gathered generality, however, and has eventuated in a number of ideas. These are an information structure, a file structure, and a file language, each progressively more complicated. The information structure I call zippered lists; the file structure is the ELF, or Evolutionary List File; and the file language (proposed) is called PRIDE.

In this paper I will explain the original problem. Then I will explain why the problem is not simple, and why the solution (a file structure) must yet be very simple. The file structure suggested here is the Evolutionary List File, to be built of zippered lists. A number of uses will be suggested for such a file, in order to show the breadth of its potential usefulness. Finally, I want to explain the philosophical implications of this approach for information retrieval and data structure in a changing world.

I began this work in 1960, with no help from anybody. Its purpose was to create techniques for handling personal file systems and manuscripts in progress. These two purposes are closely related and not sharply distinct. Many writers and research professionals have files or collections of notes which are tied to manuscripts in progress. Indeed, often personal files shade into manuscripts, and the assembly of textual notes becomes the writing of text without a sharp break.

I knew from my own experiment what can be done for these purposes with card file, notebook, index tabs, edge-punching, file folders, scissors and paste, graphic boards, index-strip frames, Xerox machine and the roll-top desk. My intent was not merely to computerize these tasks but to think out (and eventually program) the dream file: the file system that would have every feature a novelist or absent-minded professor could want, holding everything he wanted in just the complicated way he wanted it held, and handling notes and manuscripts in as subtle and complex ways as he wanted them handled.

Only a few obstacles impede our using computer-based systems for these purposes. These have been high cost, little sense of need, and uncertainty about system design.

The costs are now down considerably. A small computer with mass memory and video-type display now costs $37,000; amortized over time this would cost less than a secretary, and several people could use it around the clock. A larger installation servicing an editorial office or a newspaper morgue, or a dozen scientists or scholars, could cost proportionately less and give more time to each user.

The second obstacle, sense of need, is a matter of fashion. Despite changing economies, it is fashionably believed that computers are possessed only by huge organizations to be used only for vast corporate tasks or intricate scientific calculations. As long as people think that, machines will be brutes and not friends, bureaucrats and not helpmeets. But since (as I will indicate) computers could do the dirty work of personal file and text handling, and do it with richness and subtlety beyond anything we know, there ought to be a sense of need. Unfortunately, there are no ascertainable statistics on the amount of time we waste fussing among papers and mislaying things. Surely half the time spent in writing is spent physically rearranging words and paper and trying to find things already written; if 95% of this time could be saved, it would only take half as long to write something.

The third obstacle, design, is the only substantive one, the one to which this paper speaks.

Let me speak first of the automatic personal filing system. This idea is by no means new. To go back only as far as 1945, Vannevar Bush, in his famous article "As We May Think"[1], described a system of this type. Bush's paper is better remembered for its predictions in the field of information retrieval, as he foresaw the spread and power of automatic document handling and the many new indexing techniques it would necessitate. But note his predictions for personal filing:

> Consider a future device for individual use, which is a sort of mechanized private file and library. It needs a name, and, to coin one at random, "memex" will do. A memex is a device in which an individual stores all his books, records, and communications, and which is

mechanized so that it may be consulted with exceeding speed and flexibility. It is an enlarged intimate supplement to his memory.

It consists of a desk, and while it can presumably be operated from a distance, it is primarily the piece of furniture at which he works. On the top are slanting translucent screens, on which material can be projected for convenient reading. There is a keyboard, and sets of buttons and levers. Otherwise it looks like an ordinary desk.

....

A special button transfers him immediately to the first page of the index. Any given book of his library [and presumably other textual material, such as notes] can thus be called up and consulted with far greater facility than if it were taken from a shelf. As he has several projection positions, he can leave one item in position while he calls up another. He can add marginal notes and comments, ..." (1, 106-7)

Understanding that such a machine required new kinds of filing arrangements, Bush stressed his file's ability to store related materials in <u>associative trails</u>, lists or chains of documents joined together.

When the user is building a trail, he names it, inserts the name in his code book, and taps it out on his keyboard. Before him are the two items to be joined, projected onto adjacent viewing positions. At the bottom of each there are a number of blank code spaces, and a pointer is set to indicate one of these on each item. The user taps a single key, and the items are permanently joined.

....

Thereafter, at any time, when one of these items is in view, the other can be instantly recalled merely by tapping a button below the corresponding code space. Moreover, when numerous items have been thus joined together to form a trail, they can be reviewed in turn, rapidly or slowly, by deflecting a lever like that used for turning the pages of a book. It is exactly as though the physical items had been gathered together from widely separated sources and bound together to form a new book. It is more than this, for any item can be joined into numerous trails.

....

Thus he goes, building a trail of many items. Occasionally he inserts a comment of his own, either linking it into the main trail or joining it by a side trail to a particular item. (1, 107)

Two decades later, this machine is still unavailable*.

The hardware is ready. Standard computers can handle huge bodies of written information, storing them on magnetic recording media and displaying their contents on CRT consoles, which far outshine desktop projectors. But no programs, no file software are standing ready to do the intricate filing job (keeping track of associative trails and other structures) that the active scientist or thinker wants and needs. While Wallace[3] reports that the System Development Corporation has found it worthwhile to give its employees certain limited computer facilities for their own filing systems, this is a bare beginning.

Let us consider the other desideratum, manuscript handling. The remarks that follow are intended to apply to all forms of writing, including fiction, philosophy, sermons, news and technical writing.

* The Busn Rapid Selector, which he designed (2), is a powerful microfilm instrument, but it is not suited to idiosyncratic personal uses, nor to evolutionary modification, as described hereunder.

The problems of writing are little understood, even by writers. Systems analysis in this area is scanty; as elsewhere, the best doers may not understand what they do. Although there is considerable anecdote and lore about the different physical manuscript and file techniques of different authors, literary tradition demerits any concern with technical systems as detracting from "creativity." (Conversely, technical people do not always appreciate the difficulty of organizing text, since in technical writing much of the organization and phraseology is given, or appears to be.) But in the computer sciences we are profoundly aware of the importance of systems details, and of the variety of consequences for both quality and quantity of work that result from different systems. Yet to design and evaluate systems for writing, we need to know what the process of writing is.

There are three false or inadequate theories of how writing is properly done. The first is that writing is a matter of inspiration. While inspiration is useful, it is rarely enough in itself. "Writing is 10% inspiration, 90% perspiration," is a common saying. But this leads us to the second false theory, that "writing consists of applying the seat of the pants to the seat of the chair." Insofar as sitting facilitates work, this view seems reasonable, but it also suggests that what is done while sitting is a matter of comparative indifference; probably not.

The third false theory is that all you really need is a good outline, created on prior consideration, and that if the outline is correctly followed the required text will be produced. For most good writers this theory is quite wrong. Rarely does the original outline predict well what headings and sequence will create the effects desired: the balance of emphasis, sequence of interrelating points, texture of insight, rhythm, etc. We may better call the outlining process inductive: certain interrelations appear to the author in the material itself, some at the outset and some as he works. He can only decide which to emphasize, which to use as unifying ideas and principles, and which to slight or delete, by trying. Outlines in general are spurious, made up after the fact by examining the segmentation of a finished work. If a finished work clearly follows an outline, that outline probably has been hammered out of many inspirations, comparisons and tests**.

Between the inspirations, then, and during the sitting, the task of writing is one of rearrangement and reprocessing, and the real outline develops slowly. The original crude or fragmentary texts created at the outset generally undergo many revision processes before they are finished. Intellectually they are pondered, juxtaposed, compared, adapted, transposed, and judged; mechanically they are copied, overwritten with revision markings, rearranged and copied again. This cycle may be repeated many times. The whole grows by trial and error in the processes of arrangement, comparison and retrenchment. By examining and mentally noting many different versions, some whole but most fragmentary, the intertwining and organizing of the final written work gradually takes place***.

Certain things have been done in the area of computer manuscript handling. IBM recently announced its "Administrative Terminal System"[5,6,7,8] which permits the storage of unfinished sections of text in computer memory, permits various modifications by the user, and types up the final draft with page numbers, right justification and headers.

While this is a good thing, its function for manuscripts is cosmetic rather than organizing. Such a system can be used only with textual sections which are already well organized, the visible part of the iceberg. The major and strenuous part of such writing must already have been done.

** I understand that this account is reasonably correct for such writers as Tolstoy, Winston Churchill and Katherine Anne Porter. Those who can stick to a prior outline faithfully, like James Fenimore Cooper, tend to be either hacks or prodigies, and don't need this system.

*** For a poignant, mordant portrayal of the writer's struggle, the reader is directed to Gorey's The Unstrung Harp; or, Mr Earbrass Writes a Novel.

If a writer is really to be helped by an automated system, it ought to do more than retype and transpose: it should stand by him during the early periods of muddled confusion, when his ideas are scraps, fragments, phrases, and contradictory overall designs. And it must help him through to the final draft with every feasible mechanical aid-- making the fragments easy to find, and making easier the tentative sequencing and juxtaposing and comparing.

It was for these two purposes, taken together-- personal filing and manuscript assembly-- that the following specifications were drawn up.

Here were the preliminary specifications of the system: It would provide an up-to-date index of its own contents (supplanting the "code book" suggested by Bush). It would accept large and growing bodies of text and commentary, listed in such complex forms as the user might stipulate. No hierarchical file relations were to be built in; the system would hold any shape imposed on it. It would file texts in any form and arrangement desired-- combining, at will, the functions of the card file, loose-leaf notebook, and so on. It would file under an unlimited number of categories. It would provide for filing in Bush trails. Besides the file entries themselves, it would hold commentaries and explanations connected with them. These annotations would help the writer or scholar keep track of his previous ideas, reactions and plans, often confusingly forgotten.

In addition to these static facilities, the system would have various provisions for change. The user must be able to change both the contents of his file and the way they are arranged. Facilities would be available for the revising and rewording of text. Moreover, changes in the arrangements of the file's component parts should be possible, including changes in sequence, labelling, indexing and comments.

It was also intended that the system would allow index manipulations which we may call dynamic outlining (or dynamic indexing). Dynamic outlining uses the change in one text sequence to guide an automatic change in another text sequence. That is, changing an outline (or an index) changes the sequence of the main text which is linked with it. This would permit a writer to create new drafts with a relatively small amount of effort, not counting rewordings.

However, because it is necessary to examine changes and new arrangements before deciding to use or keep them, the system must not commit the user to a new version until he is ready. Indeed, the system would have to provide spin-off facilities, allowing a draft of a work to be preserved while its successor was created. Consequently the system must be able to hold several-- in fact, many-- different versions of the same sets of materials. Moreover, these alternate versions would remain indexed to one another, so that however he might have changed their sequences, the user could compare their equivalent parts.

Three particular features, then, would be specially adapted to useful change. The system would be able to sustain changes in the bulk and block arrangements of its contents. It would permit dynamic outlining. And it would permit the spin-off of many different drafts, either successors or variants, all to remain within the file for comparison or use as long as needed. These features we may call evolutionary.

The last specification, of course, one that emerged from all the others, was that it should not be complicated.

These were the original desiderata. It was not expected at first that a system for this purpose would have wider scope of application; these jobs seemed to be quite enough. As work continued, however, the structure began to look more simple, powerful and general, and a variety of new possible uses appeared. It became apparent that the system might be suited to many unplanned applications involving multiple categories, text summaries or other parallel documents, complex data structures requiring human attention, and files whose relations would be in continuing change.

Note that in the discussion that follows we will pretend we can simply see into the machine, and not worry for the present about how we can actually see, understand and manipulate these files. These are problems of housekeeping, I/O and display, for which many solutions are possible.

Elements of the ELF

What was required we may call an evolutionary file structure: a file structure that can be shaped into various forms, changed from one arrangement to another in accordance with the user's changing need. It was apparent also that some type of list structure was necessary. Making the file out of lists would allow different categories of personal notes, separate drafts, outlines and master indices all to be handled as lists of some sort; their segments could then be manipulated through automatic handling of index numbers. The resulting file structure I will accordingly call the Evolutionary List File, or ELF, since it is an evolutionary file structure constructed with lists. The system proposed here is not the only ELF possible. It is built upon a specific technique of attaching lists together which has a natural resistance to becoming confused and messy.

As computer-based systems grow in capability and diversity of uses, they tend to become more and more cluttered with niggling complications, hidden passageways, and lurking, detailed interlocks, restrictions, specializations, provisos. These should be forsworn, if possible, in the system under discussion, so that it might be attractive to laymen (including artists and writers) who feel unkindly disposed toward computers. It should readily adapt to their own styles of handling things, imposing few conventions or methods of use. How could this imposition be avoided? And among so many interesting and possible system functions and file relations, how may the users know what connections to make, how may they understand what they are doing, and how may they avoid muddling and losing the things they are working with?

The answer, I think you see, is to choose a very simple structure that can be used and compounded in many different ways. The basic arrangement chosen for these purposes is an information structure I will refer to as zippered lists. (We might call it permutation-invariant one-for-one inter-list entry-linking, but that is not necessary.)

There are only three kinds of things in the zippered-list ELF, with no predetermined relations among them-- no hierarchies, machine-based features or trick exceptions. The system is user-oriented and open-faced, and its clear and simple rules may be adapted to all purposes.

The ELF has three elements: entries, lists and links. An entry is a discrete unit of information designated by the user. It can be a piece of text (long or short), a string of symbols, a picture or a control designation for physical objects or operations.

A list is an ordered set of entries designated by the user. A given entry may be in any number of lists.

A link is a connector, designated by the user, between two particular entries which are in different lists (Figure 1). An entry in one list may be linked to only one entry in another list.

On the left we see two zippered lists. Between the entries of list A and those of B are dashed lines, representing the links between the two lists. On the right is the table of links as it might look to a machine. The machine can read this table from right to left or left to right, finding entries in B that correspond to given entries in A, or vice versa. A change in the sequence of either list, or additions to either list, will not change the links that stand between them. Changes in the link structure will occur only if the user specifically changes the links, or if he destroys entries which are linked to others.

To be technical, then, two lists are zippered if there are any pairwise links between their respective elements, each element is in no more than one link pair, and these links are unaffected by permutation of the lists, remaining affixed to the same pairs of elements. It is not required that the two lists be of the same length, or, even if they are, that all entries have a link to the other list.

The ELF's File Operations

Zippered lists are an information structure; the Evolutionary List File is a file structure. The ELF described in this paper holds its contents exclusively as zippered (or unzippered) lists. But the file structure must also include a set of operations by which it may be modified. These file operations exist for creating, adjusting or removing the entry, list and link, and for manipulating the sequence relation. An ELF is actually any machine which will, on command, carry out the basic operations on entry, list, link and sequence.

Entries. The user may create new entries at any time, putting anything in them that he thinks appropriate. Entries may be combined or divided (unless indivisible, like objects, commands, etc.) Entries may be put in any list, and the same entry may be put in different lists. The user may direct that entries of one list be automatically copied onto another list, without affecting the original list.

Lists. The user may create lists and assign entries to them. He may at will make new copies of lists. He may rearrange the sequence of a list, or copy the list and change the sequence of that copy. Lists may be combined; lists may be cut into sublists.

Links. The user may create links between entries that are in different lists. Any number of legal links may be created, although the upper limit of links between any two lists is determined by the 1-for-1 rule. When an entry or a list is copied into a list, links will remain between parent and daughter entries. Moreover, after a list-copying operation, the daughter list will have the same links to all other lists as does the parent list.

Sequences. The user may put a list in any sequence he wishes. (A copied list will maintain the original sequence until modified.) Sequences may be transferred between lists via the links: if the sequence of A is transferred to B, each entry of A linked to an entry in B takes the sequential position of its linked

entry in B.

No definite meaning is assigned to these entities or operations by the system; the user is free to let them mean anything he likes. A list may be a category, trail, index, dialogue, catalogue or poem, and lists may be assembled into larger structures. The ELF may be thought of as a place; not a machine, but a piece of stationery or office equipment with many little locations which may be rearranged with regard to one another****.

Note that zippered lists generate only one of various possible Evolutionary List Files. Indeed, the description of the file structure given here is in some ways restrictive: the ELF could take a number of other, closely similar forms and still be much the same thing. For example, it would be possible to allow subentries and superentries into the file, to behave and link up like normal entries, even though they contained or were contained in other entries. But the equivalent can be done with the current system. Another possibility would be to allow links other than 1-for-1; these could be modal, the different link-modes having different meanings to the user. Or we might make it an evolutionary network file, allowing any two entries to be connected. Or, besides such general changes in the rules, plausible changes and accessory functions for any purposes could be introduced outside the given file structure, even including modifications and widgets to do some of the same things "more easily."

But to the user such complication might render the system far less handy or perspicuous. The ELF, with its associated techniques as described above, is simple and unified. Many tasks can be handled within the file structure. This means it can be of particular benefit to people who want to learn without complications and use it in ways they understand. For psychological, rather than technical reasons, the system should be lucid and simple. I believe that this ELF best meets these requirements.

Technical Aspects

Since the ELF description above bears some resemblance to the list languages, such as IPL, SLIP, etc., a distinction should be drawn. These list languages[9] are particularly suited to processing data, fast and iteratively, whose elements are manipulable in Newell-Shaw-Simon lists. Essentially they may be thought of as organizations of memory which facilitate sequential operations on unpredictably branching or hierarchical data. These data may change far too quickly for human intervention. Evolutionary file structures, and the ELF in particular, are designed to be changed piecemeal by a human individual. While it might be convenient to program an ELF in one of these languages, the low speed at which user file commands need to be executed makes such high-powered implementation unnecessary; the main problem is to keep track of the file's arrangements, not to perform computation on its contents. Although work has been done to accommodate the list-language approach to larger chunks of material than usual[10], the things people will want to put into an ELF will typically be too big for core memory.

The ELF does in fact share some of the problems of the list languages: not available-storage accounting or garbage collection (concerns associated with organization of fast memory for processing, which may be avoided at slower speeds), but the problems of checkout for disposal (what other lists is an entry on?) and list naming. The former problem is rather straightforwardly solved[11, p. 164]; the latter is complicated in ways we cannot go into here.

**** An ELF might even be constructed out of cards, blocks, sticks and strings, using techniques of puppetry, but this would not be a convenient object.

The ELF appears to be closest, topologically and in other organizing features, to the Multilist system described by Prywes and Gray[12]. Like that system, it permits putting entries in many different lists at once. However, in current intent[13] that system is firmly hierarchical, and thus somewhat removed from the ELF's scope of application. Another closely related system is the Integrated Data Store of Bachman[14,15,16,17,18]; this is intended as a hardware-software system for disc I/O and storage arrangement, but in its details it seems the ELF's close relative. Each of these systems has a connection logic that might be feasible as a basis for an ELF different from this one. Or, either might prove a convenient programming base for the implementation of this file structure.

Another obvious technical question must be considered. How can the ELF allow "unlimited" copies of entries and lists? By patching techniques, of course. Variant entries and lists can take virtually no space, being modification data plus pointers to the original. When a modified version of a list or entry is created, the machine patches the original with the changes necessary to make the modified version. (Figure 2)

USES

In the discussion that follows, we will examine various possible applications of zippered lists and the ELF, and postpone discussing the file language they require. Finally we will return to this problem, and describe the file language PRIDE whose additional features are needed to adapt the ELF for the uses originally discussed.

By assigning entries to lists, the ELF may be used as a glorified card file, with separate lists used for categories, trails, etc. This permits extensive cross-indexing by the assignment of one entry to different lists. It permits subsets and sub-sequences for any use to be held apart and examined without disturbing the lists from which they have been drawn, by copying them onto other, new lists. The ELF permits the filing of historical trails or associative (Bush) trails through documents, business correspondence, belles-lettres, case law, treaties, scholarly fields and history, and the mixture of trail with categorical filing.

These are the simple uses; the compound uses are much more interesting. But since we cannot intuitively fit every possible conceptual relationship into zippered lists, imaginative use is necessary. Remember that there is no <u>correct</u> way to use the system. Given its structure, the user may figure out any method useful to him. A number of different arrangements can be constructed in the ELF, using only the basic elements of entry, list and link. Zippered lists may be assembled into rectangular arrays, lattices and more intricate configurations. These assemblies of lists may be assigned meaning <u>in combination</u> by the user, and the system will permit them to be stored, displayed, taken apart for examination, and corrected, updated, or modified.

By using such combining arrangements on lists composed of text, the file can be self-documenting, with all labelling and documentation kept integrally within the file structure. It is thus possible to incorporate, in a body of information filed in the ELF, various levels of index, summary, explanation and commentary. Many useful ways of listing and linking such documentation are possible. In Figure 3 we see some of the ways that documentary lists may be linked together. The lists shown are outline, suboutline, draft, subdraft, summary, commentary and source list. These are not all the possible types of documentary lists; for example, "footnotes" are omitted. The ELF will permit any number of these documentary lists;

observe that they can be built on one another, and indefinitely compounded. The system will have no trouble accepting a commentary on a commentary on a subdraft of an outline for a variant list of source materials.

Figure 3 shows also how two lists may contain some of the same entries. The dashed line represents linkage between entries, the solid line shows that both lists contain the same entry. This may be useful for creating alternate versions, or, as in this example, the lists containing the same entry may have different purposes. Here, for instance, an entry in the summary is also to be found in the main draft.

This self-documentation feature permits any string of text in the ELF, long or short, to be annotated or footnoted for scholarly or other purposes. Such marginalia can be temporary or permanent, for the private memoranda of an individual or for communication among different persons using the file.

In a like manner, the ELF is capable of storing many texts in parallel, if they are equivalent or linked in some way. For example, instruction manuals for different models of the same machine may be kept in the file as linked lists, and referred to when machines are to be compared, used or fixed. This is of special use to repairmen, project managers and technical writers.

Moreover, the ELF's cross-sequencing feature -- the fact that links ignore permutations-- permits the collation of very different cognate textual materials for comparison and understanding. In law, this would help in comparing statutes (or whole legal systems); in literature, variorum editions and parodies. Thus such bodies as the Interpreter's Bible and a Total Shakespeare (incorporating Folios, bowdlerizations, satires and all critical commentary) could be assembled for study.

Let me try to illustrate the possible comprehensiveness and versatility of this file structure as applied to texts. Figure 4 shows the different arrangements that might be used by one man-- in this case an historian writing a book-- to assemble and integrate his intellectual and professional concerns. Although it is impossible to show the links between all the separate entries of these lists-- the entries are not themselves discernible in this drawing-- it is possible to note the kinds of links between lists. A thin line between lists shows that some links exist; a solid line indicates that some entries of both lists are the same.

Perhaps this looks complicated. In fact, each of the connectors shows an indexing of one body of information to another; this user may query his file in any direction along these links, and look up the parts of one list which are related to parts of another. Therefore the lines mean knowledge and order. Note that in such uses it is the man's job to draw the connections, not the machine's. The machine is a repository and not a judge.

The ELF may be an aid to the mind in creative tasks, allowing the user to compare arrangements and alternatives with some prior ideal. This is helpful in planning nonlinear assemblages (museum exhibits, casting for a play,) or linear constructions of any kind. Such linear constructions include not only written texts; they can be any complicated sequences of things, such as motion pictures (in the editing stage) and computer programs.

Indeed, computer programming with an on-line display and the ELF would have a number of advantages. Instructions might be interleaved indefinitely without

resorting to tiny writing. Moreover, the programmer could keep up work on several variant approaches and versions at the same time, and easily document their overall features, their relations to one another and their corresponding parts. Adding a load-and-go compiler would create a self-documenting programming scratchpad.

The natural shape of information, too, may call for the ELF. For instance, sections of information often arrange themselves naturally in a lattice structure, whose strands need to be separately examined, pondered or tested. Such lattices include PERT networks, programmed instruction sequences, history books and genealogical records. (The ELF can handle genealogical source documentation and its original text as well.) Indeed, any informational networks that require storage, handling and consideration will fit the ELF; a feature that could have applications in plant layout, social psychology, contingency planning, circuit design and itineraries.

The ELF may, through its mutability, its expansibility, and its self-documentation features, aid in the integration, understanding and channeling of ideas and problems that will not yield to ordinary analysis or customary reductions; for instance, the contingencies of planning, which are only partially Boolean. Often the reason for a so-called Grand Strategy in a setting is that we cannot keep track of the interrelations of particular contingencies. The ELF could help us understand the interrelations of possibilities, consequences, and strategic options. In a logically similar case, evaluating espionage, it might help trace consistencies and contradictions among reports from different spies.

The use of an ELF as the basis for a management information system is not inconceivable. Its evolutionary capability would provide a smooth transition from the prior systems, phasing out old paperwork forms and information channels piecemeal. Beginning with conventional accounting arrays and information flow, and moving through discrete evolutionary steps, the ELF might help restructure an entire corporate system. Numerical subroutining could permit the system to encompass all bookkeeping. The addresses of all transaction papers, zippered to lists of their dates and contents, would aid in controlling shipments, inventory and cash. The ELF's cross-sequencing feature could be put to concrete uses, helping to rearrange warehouses (and the company library) by directing the printout of new labels to guide physical rearrangement. Inventories, property numbers and patents could be so catalogued and recatalogued in the ELF. Legal documents, correspondence, company facts and history could be indexed or filed in historical and category trails. And upper management could add private annotations to the public statements, reports and research of both the organization and its competitors, with amendments, qualifications, and inside dope.

PRIDE

While the ELF as described is expected to be general and useful, the original purposes described at the beginning of this paper call for certain further provisions. Now I would like to describe a desirable file and information handling language that will meet these needs, called the PRIDE (Personalized Retrieval, Indexing, and Documentation Evolutionary) System. Its purpose is to facilitate the use of an ELF. The system described is not yet implemented, nor even fully specified, but let us speak as though it is.

PRIDE includes the ELF operations. However, for safety and convenience nearly every operation has an inverse. The user must be permitted, given a list of what he has done recently, to undo it. It follows that "destroy" instructions must

tail safe; if given accidentally, they are to be revocable. For safety's sake, it should take several steps to throw a thing away completely. An important option would permit the user to retrace chronologically everything he does on the system.

Most of PRIDE's applications will involve text handling, either as a primary purpose or in the documentation of some other task. Hence a number of features exist for convenient text usage. Text handling commands (for modifying entries) include the equivalents of standard proofreader's marks for insertion, deletion and switching of sections.

Also for text usage and user comfort, there are certain system non-restrictions. There is no practical restriction on the length of an input entry, and it need follow only the most trivial format conventions. In addition, the machine will interrupt any other PRIDE function to receive input text (inspiration mode). It is necessary that entries of unspecified length be acceptable to the system without fuss or warning. PRIDE does not stipulate fixed record lengths, either for input or storage; any such restrictions would have a psychologically cramping effect. There is no reason the system cannot appear to the user to have no fixed or standard unit lengths; the machine's operating units and sections should not concern him.

Ideally, neither the length of entries, the number of lists, or any other parameter of a file is restricted by anything but the absolute size of all memory. This is a difficult requirement for the programmer. Routinely, however, the system should be able to accept entries thousands of characters long, accept hundreds of entries to a list, and accept hundreds of lists in the file. Otherwise, extraneous consideration by the user of whether there's room to add material or try out an offshoot begins to interfere with the system's use.

Although I have avoided discussing the means by which the user sees his file, PRIDE must, of course, have functions and commands for this purpose. For a CRT these include quick lookup schemes[19], preferably with moving menus and means of readily changing the hierarchy of lookup structure; as well as visual cuing and mnemonic formats, including cursor maneuvers, overlays and animated wipes and other transitions. But such glamorous features do not reduce the challenge or worth of working through a line printer, or seeking to make the system useful under a batch-processing monitor.

Many instructions aside from those already mentioned will be needed by the user; particular applications will require such operations as text lookup and integer arithmetic. And surely all the uses of the system have not been anticipated. Hence a subroutining facility is to be available, reaching to assembly language or opening into the machine's other languages. This could be used for processing the file's contents (e.g., numbers or character strings), or for creating more convenient combined operations out of the different operations dealing with file structure, input-output and text.

PRIDE is one possible way to make an ELF, or any evolutionary file structure, useful. PRIDE would be a foreground, free-standing language with the primary mission of handling files and manuscripts, as discussed at the beginning, and secondary applications in ordering and documenting other kinds of complex information. Its major use would presumably be in connection with time-shared display and information systems. But such a language is only one suggestion. Actually, there is not much reason that the ELF could not be made a standard file structure for all purposes; unused capabilities would not intrude, but would still be there if unex-

pectedly wanted. ELF systems could be built into the file capabilities of general utility software. The actual computation involved is relatively trivial, and the ELF could easily be incorporated into I/O routines or data channel languages. Even small-scale hardware implementations are not unthinkable; a control box between a typewriter and a tape recorder, for instance.

All these applications depend, of course, on the system's being actually useful, which is an empirical question. A number of possible applications have been mentioned. But, except as a crutch to man's fallible mind, is there any reason to suppose that the system has any general applicability in principle?

Philosophy

As "philosophy" I want to speak of two major things. First, complex file structures (like the ELF) make possible the creation of complex and significant new media, the hypertext and hyperfilm. Second, evolutionary file structures (like the ELF) make it possible to keep track of things that have been changing, without our awareness, all along. These include the major categories of human thought, which will go on changing.

Systems of paper have grave limitations for either organizing or presenting ideas. A book is never perfectly suited to the reader; one reader is bored, another confused by the same pages. No system of paper-- book or programmed text-- can adapt very far to the interests or needs of a particular reader or student.

However, with the computer-driven display and mass memory, it has become possible to create a new, readable medium, for education and enjoyment, that will let the reader find his level, suit his taste, and find the parts that take on special meaning for him, as instruction or entertainment.

Let me introduce the word "hypertext"***** to mean a body of written or pictorial material interconnected in such a complex way that it could not conveniently be presented or represented on paper. It may contain summaries, or maps of its contents and their interrelations; it may contain annotations, additions and footnotes from scholars who have examined it. Let me suggest that such an object and system, properly designed and administered, could have great potential for education, increasing the student's range of choices, his sense of freedom, his motivation, and his intellectual grasp******. Such a system could grow indefinitely, gradually including more and more of the world's written knowledge. However, its internal file structure would have to be built to accept growth, change and complex informational arrangements. The ELF is such a file structure.

Films, sound recordings, and video recordings are also linear strings, basically for mechanical reasons. But these, too, can now be arranged as non-linear systems-- for instance, lattices-- for editing purposes, or for display with different emphasis. (This would naturally require computer control, using the ELF or a related system, and various cartridge or re-recording devices.) The hyperfilm-- a browsable or vari-sequenced movie-- is only one of the possible hypermedia that require our attention.

So much for what we can create afresh with this structure. What about the things that have already been around awhile?

The physical universe is not all that decays. So do abstractions and categories. Human ideas, science, scholarship and language are constantly collapsing

***** The sense of "hyper-" used here connotes extension and generality; cf. "hyperspace." The criterion for this prefix is the inability of these objects to be comprised sensibly into linear media, like the text string, or even media of somewhat higher complexity. The ELF is a hyperfile.

****** I will discuss this idea at length elsewhere.

and unfolding. Any field, and the corpus of all fields, is a bundle of relationships subject to all kinds of twists, inversions, involutions and rearrangement: these changes are frequent but unpredictable. Recall that computers, once a branch of mathematics, are now their own field (but the development of fluid logic indicates a possible merger with the art of wind instruments). Social relations, psycholinguistics and psychonomics are new fields, even though they rest on no special discoveries; political economy, natural history and social ethics are gone. Within a given area, too, the subheadings of importance are in constant flux. In the social sciences, for instance, the topic headings of the nineteen-thirties now sound quaint.

While the disappearance and up-ending of categories and subjects may be erratic, it never stops; and the meaning of this for information retrieval should be clear. Last week's categories, perhaps last night's field, may be gone today. To the extent that information retrieval is concerned with seeking true or ideal or permanent codes and categories-- and even the most sophisticated "role indicator" syntaxes are a form of this endeavor-- to this extent, information retrieval seems to me to be fundamentally mistaken. The categories are chimerical (or temporal) and our categorization systems must evolve as they do. Information systems must have built in the capacity to accept the new categorization systems as they evolve from, or outside, the framework of the old. Not just the new material, but the capacity for new arrangements and indefinite rearrangements of the old, must be possible. In this light, the ELF, indefinitely revisible and unperturbed by changes in overall structural relations, offers some promise.

There is, then, a general rationale. I believe that such a system as the ELF actually ties in better than anything previously used with the actual processes by which thought is progressively organized, whether into stories or hypertext or library categories. Thus it may help integrate, for human understanding, bodies of material so diversely connected that they could not be untangled by the unaided mind. For both logistic and psychological reasons it should be an important adjunct to imaginative, integrating and creative enterprises. It is useful where relationships are unclear; where contingencies and tasks are undefined and unpredictable; where the structures or final outcome it must represent are not yet fully known; where we do not know the file's ultimate arrangement; where we do not know what parts of the file are most important; or where things are in permanent and unpredictable flux. Perhaps this includes more places than we think. And perhaps here, as in biology, the only ultimate structure is change itself.

CONCLUSION

This paper has proposed a different kind of structure for handling information.

Essentially it is a file with certain storage provisions which, combined, permit the file's contents to be arranged any-which-way, and in any number of ways at once. A set of manipulation functions permits making changes or keeping track of developments. The file is capable of maintaining many different arrangements at the same time, many of which may be dormant. This makes ordinary measures of efficiency inappropriate; as with high fidelity music systems, enrichment is derived from the lavish use of surplus capacity.

The key ideas of the system are the inter-linking of different lists, regardless of sequence or additions; the re-configurable character of a list complex into any humanly conceivable forms; and the ability to make copies of a whole list, or

list complex-- in proliferation, at will-- to record its sequence, contents or arrangement at a given moment. The Evolutionary List File is a member of the class of evolutionary file structures; and its particular advantages are thought to be psychological, not technical. Despite this file's adaptability to complex purposes, it has the advantage of being conceptually very simple. Its structure is complete, closed, and unified as a concept. This is its psychological virtue. Its use can be easily taught to people who do not understand computers. We can use it to try out combinations that interest us, to make alternatives clear in their details and relationships, to keep track of developments as they occur, to sketch things we know, like or currently require; and it will stand by for modifications. It can be extended for all sorts of purposes, and implemented or incorporated in any programming language.

There are probably various possible file structures that will be useful in aiding creative thought. This one operates, as it were, on lists that hook together sideways, and their copies. There may be many more.

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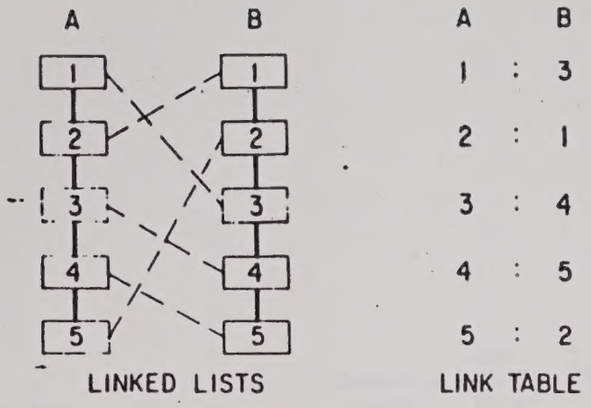

***FIGURE 1*—Zippered lists: 1-for-1 links between entries are invariant under list permutation.**

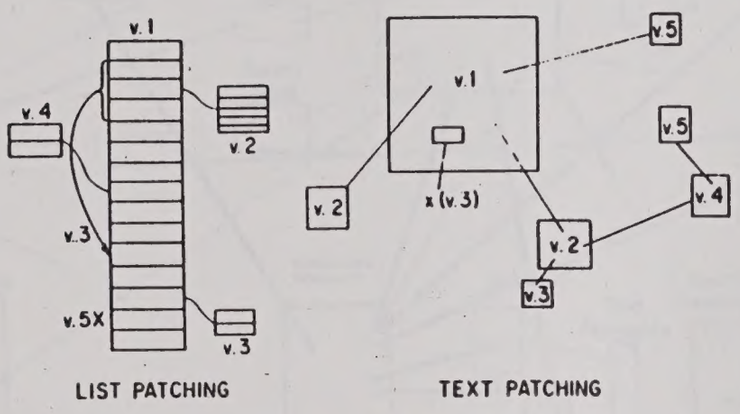

***FIGURE 2*—Spinoff of variants: extra versions need little space.**

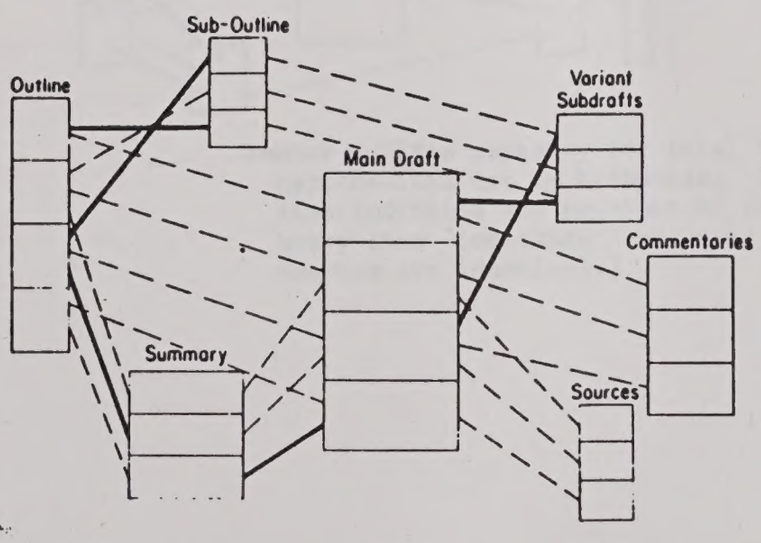

***FIGURE 3*— All levels of documentation may be contained in the ELF. (Heavy lines indicate that linked entries are identical.)**

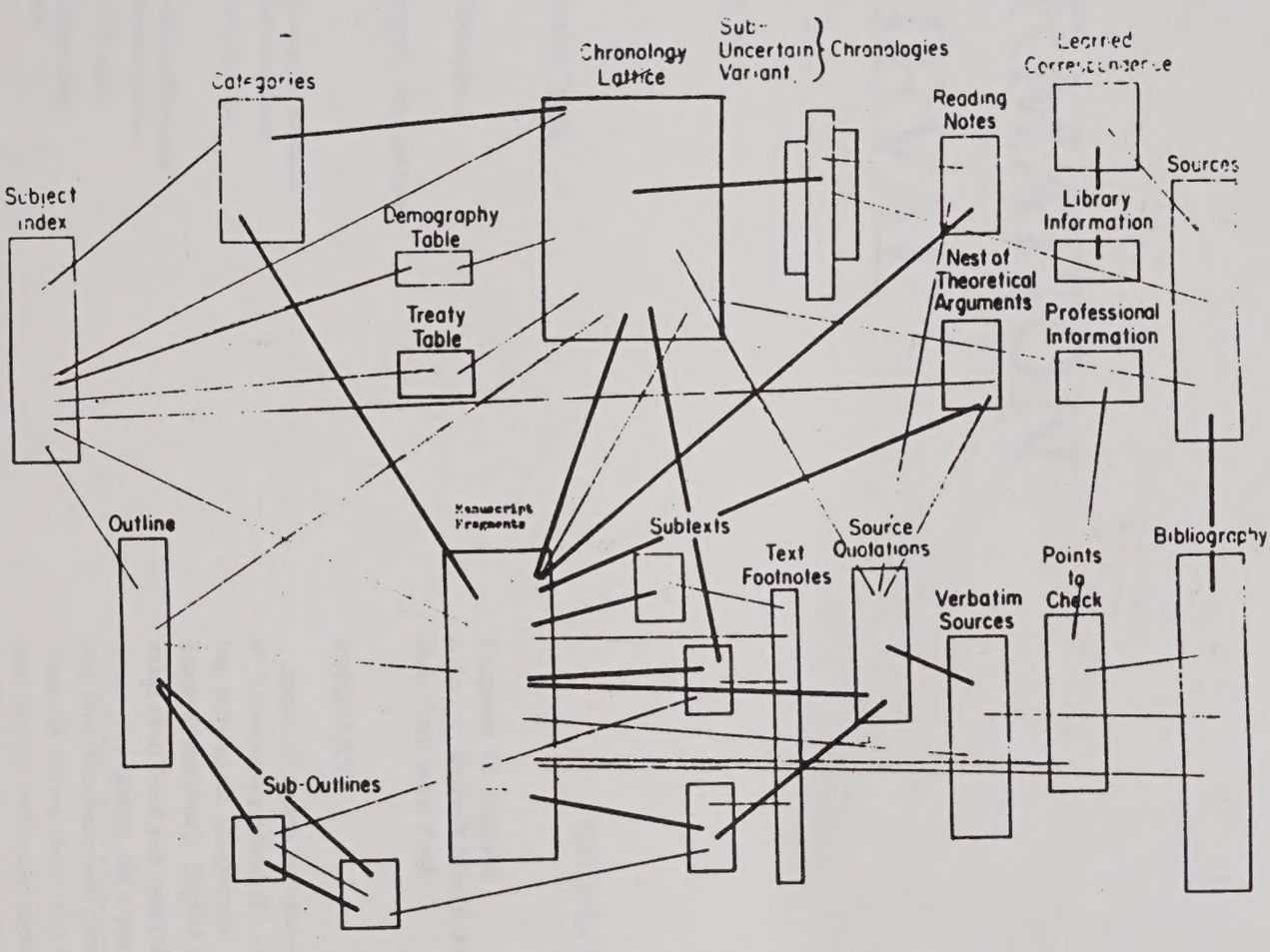

FIGURE 4 – ELF's capacity for total filing: hypothetical use by historian. (A thin line indicates the presence of links; a heavy line indicates that some linked entries are identical.)

INFORMATION RETRIEVAL

A Critical View

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GETTING IT OUT OF OUR SYSTEM

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SUMMARY

Specialist access and muster of information—usually the underlying task of "information retrieval"—may not be best accomplished either by indexing techniques (document retrieval) or queriable information networks (content retrieval). Digital text storage and display make possible the creation of at least one potentially powerful *medium*: the hypertext, or nonlinear text system. As a medium, not a facility, it will share traits of book and film. Machines will present complex interconnected text units to users who will weave their way through them at a glowing screen. Successive user choices will evoke successive presentations which have been created—written and structurally designed, and signed—by individuals and teams. Departing completely from the convention of linear text as we know it, the hypertext will probably be much more effective for everything.

Several parallels exist between the (potential) development of the hypertext medium and the actual development of the motion picture in its early years: the inventors of the technology underestimated the importance and generality of the resulting medium; techniques of predecessor media were imported to it, and the techniques and structure peculiar to it took some years to develop; the character of its units was not at once discovered; and credit to a work's creators was for a time thought unimportant. Films had

one special advantage: a standardized technical context existed to make the exchange of units simple.

INTRODUCTION

What do we want to get out of an information system? There is a great need to turn the new machines—computers, mass memories, and dynamic displays—into information systems, or, to be more precise, information storage and supply systems (as distinct from systems for information processing.) But how are they to work, and what are they to do?

What do we want to get out of an information system? The way we answer this rhetorical question probably settles the major aspects of the system we design. The hard-nosed answer is "Documents." The dreamy-eyed answer is "Pure information." The hesitant answer is to ask another question, "What sorts of things is the system for?" Let us probe this subquestion neutrally. If we try to think in terms that avoid the stereotypes and commitments of information retrieval, perhaps we can find a new way of seeing the problem context, and better understand the conventional solutions for what they are and do.

What do we want to get out of an information system? The information problem I will confront here is the overall question of how to keep specialists informed and updated. To give it an acronym, I would venture that existing systems are *Specialist Access* and *Muster* of *I*nformation (SAMI for short). To speak of "access and muster" avoids the connotations of "retrieval"—that the information has been lost, prodigal, or shot down in the bushes. (We will exclude other possible meanings of the term "information retrieval," considering library inventory systems to be a temporary expedient, and management information to be a job for real-time systems programming.) I will propose that SAMI is best served, not by document retrieval or content retrieval, each in its way more conventional than it looks, but by something else again. This paper is an elaborate conjecture which I hope to give verisimilitude by an extended historical analogy.

"INFORMATION RETRIEVAL"

Information retrieval in the present sense now means two things. One, document retrieval, uses standardized indexing techniques to draw desired classes of unit documents from a central pool. The other, content retrieval, holds a body of integrated knowledge to which the user may address questions. (For a unified treatment of the two types, see Licklider.[1]) Each is important.

A. DOCUMENT RETRIEVAL

Let us examine the first meaning of information retrieval, document retrieval (DR), the finding of documents having certain indexed descriptions. In document retrieval we index a collection of documents by particular terms or aspects, and later only get things back *through* those terms. This approach retains the unit of the discrete "document," taking it as given. The documents themselves are not expected to have any provision for the system, or to have been created with any relation to the system in mind, but are produced by the world according to external causes. The document is integrally sacrosanct, its content and form untouched by the system. No tampering, excerpting or post-editing of the documents is permissible, no matter how useful it might be.

The problem of the system then becomes finding "the right" documents, which the user recognizes by criteria of his own. The match between the user's private criteria and the available indexing is indicated by the number of "hits"—documents the user is pleased with.

Studies of library use have indicated that not very much library use could be aided by conventional document retrieval systems as currently construed. This would be all right if we could be sure they were good for something else.

That is one criticism of document retrieval: it is not yet clear that document-retrieval systems will do what the users need to have done, even in some ordinary sense, and before we start reforming the users.

The second criticism of document retrieval is based on the nature of the indexing, or categorization, process. (Indexing is categorization, even when it becomes complicated with the relational tagging of roles and links.)

The best categories, and indices, decay. In principle any indexing categories will progressively decline in relevance. It is quite reasonable to expect that as emphasis and interests change in a field, many or most indexing categories for information retrieval will gradually fall apart. A cursory examination of the Dewey Decimal System should confirm this point. If the structure of a particular field strays from the way the original indexing saw it, we will look in the wrong place for the information that was put away earlier.

B. CONTENT RETRIEVAL

The second sense of information retrieval now being used is content retrieval (CR). Content retrieval is often called "fact retrieval"; a system for content retrieval is sometimes called the QAS, or question-answering system. (An excellent source on CR is Simmons.[2])

Such systems can be seen as having two parts; some overall method of storing a complex network of interrelated information, such as that of Marill,[3] and a program mechanism for following through its different parts to find something out. Network and query programs are intertwined; the design of one has consequences for the other. However, for the present purposes we may call such a system the "queriable information network," since the information network is the basic part; in principle a way can presumably be found to interrogate any adequate logistic system.

Content retrieval discards the unit of the document. The total contents of a queriable information network need not be divided into units at all, except those described in the information and those required to represent it.

Such systems offer great promise in a number of ways. However, they do have present and future drawbacks. Whether such systems can replace significant amounts of library use cannot be ascertained. Second, preparing information to go into the queriable information network may be an extremely difficult, touchy and expensive business, at least as things look now. For some systems, coders may require training in mathematical notations of great complexity. Third, conversing with such a machine will on some systems usually, and in the most lucid systems sometimes,[4] require formulating questions in arcane languages or dialects. Either these can be known only to specialists, or their use by the laity may lead to mistakes.

The major problem, though, and the real long-term drawback, is analogous to the decay of categories and indices in DR. Content retrieval assumes that all the information in the network is *consistent and true*, and has no inconvenient gaps. Like any overview, CR must ignore uncertainties and lacunae, and (as "knowledge" is revised and interests shift) it may leave only the tintype of a certain moment's concerns. As scientific and other beliefs are constantly changing, "knowledge" must frequently be readjusted or rearranged.

Actually, the idea of "knowledge" is misleading in this context. What we regard as knowledge includes various contradictory sets of interwoven propositions, clusters of argument, and discrepancies of faith, taste and emphasis in the literature. There is usually disagreement in every field of knowledge. This means that, in a queriable information network, different and mutually contradictory theories really ought to be able to coexist within the system.

Moreover, we may surmise that in most fields of knowledge some noncontroversial information is incorrect, but we don't know which. It follows that unless the information network can be modified as systems of information are modified, the information network will be left behind. While evolutionary and patching modifications might be arranged to cope with the

representation of changing views, this expands the problem significantly. (For more on such evolutionary issues and difficulties, see Nelson.[5])

MANIFESTO

I would like to make the claim that document and content retrieval systems are not the principal nor the basic use of computers for handling ideas. I am not claiming that such systems are useless or improper. Rather, I think they will be helpful accessories to the proper, natural and true use of computers for handling the written word.

Systems thinkers have proposed a great variety of possible arrangements for ordering man's thoughts and aiding his mind with the computer. I would like to propose that this diversity of possible facilities and functions is in fact comprisable into an *organized text medium*, to be created and used by people and for people. This organized medium will be that of the text structure created expressly for on-line display by the computer. Such a text will be read from an illuminated screen, the cathode-ray display; it will respond or branch upon actions by the user. It will be a succession of displays, largely textual, that come and go according to his actions. Such a congeries of interconnected text may incorporate and have available many chunks of literature on a given subject, or many subjects, purposely assembled and woven together by authors and editors. The name for this new medium is hypertext.[6]

Hypertext is the combination of natural-language text with the computer's capacities for interactive, branching or dynamic display, *when explicitly used as a medium*. Or, to define it more broadly, "hypertext" is the generic term for any text which cannot be printed (or printed conveniently) on a conventional page, or used conveniently when bound between conventional covers. "Non-linear text" might be a fair approximation. Hypertext may differ from ordinary text in its sequencing (it may branch into trees and networks), its organization (it may have multiple levels of summary and detail), its mode of presentation (it may contain moving or manipulable illustrations, moving or flashing typography), and so on. At last, with the appearance of the computer display and appropriate back-up systems, such texts are possible and practical.

We will store natural-language texts in digital devices for dynamic display, and arrange them into new kinds of units. This means discarding customary document boundaries, and organizing the materials in a complex and non-linear fashion. The user will read from a screen, and as he goes he will make choices that call connected materials into view. Hypertext will be a medium, not a facility, and the institutions of authorship, citation,

academic commentary and argument will be preserved and incorporated in an orderly fashion.

Thousands (or millions) of paragraphs of source material may be available directly to the inquiring reader who wishes further detail, or a certain person's comment, or a specific idea or sentence. Moreover, the *original context* of such items may be summoned, and such contexts—articles, books, or other hypertext units—themselves examined. Thus the reader in search of understanding may continually uncover new elements of interest, often of growing relevance to his hunches, his confusions and his unphrased questions. He can find explanations, ideas, or whole new areas that are to his interest. He may study them through further excerpts, reviews, summaries, or even conventional reading.

The reader will explore, light pen in hand, browsing or studying closely, choosing paths he prefers, criss-crossing these paths on summary levels, stepping from section to section and stopping for deeper work in units of interest. He will come to understand the whole, or a general section, like a walker exploring a city.

Hypertexts will require no special training to use, and rather little special training to create, though like works in other media they can be made either well or poorly. To use, or read, a hypertext, you will need mainly to sit at a screen, read, and indicate choices by pushbutton or light pen. To create a hypertext, you will type in new text and indicate the new relational connections (and their operational meaning) to the system. Where you wish to establish fixed sequences or give a test, you will also state what user's action is to evoke what presentation.

There is reason to suppose that hypertext systems, once created, will serve a range of purposes. These will include the informing of professionals, education, briefings, giving directions, and even providing leisure reading. In the present SAMI context, this generality is not accidental but necessary. While we will not discuss hypertexts for education in this article, we will discuss the need for this generality in satisfying the customary purposes of information retrieval.

Of course it is risky to speculate on what the particular forms and uses of hypertext will be, since its actual presence and demonstration should swiftly outstrip speculation; until then we can have little feel for it. For any but conventional text, we have little notion of the comparative sense or utility of different sequences and structures. All that we can tell at this time is that there are many possibilities. Until the money is spent to try it, speculation is all we can do. But let us do that.

GENERAL TEXT STRUCTURES

Let us consider in the abstract some of the ways that hypertext may be organized. We will assume the use of some machine capable of presenting the texts in any arrangement, sequence or response network that we wish to plan. What ways are there? (To save space and accentuate continuity with the present, we will refer only to "text structures," recognizing that arrangements which depart from the printable collectively deserve the term "hypertext.")

A. TEXT UNITS

Text structures are composed of units. These units may be for convenience(the page of typescript) or have some meaning (the paragraph; the book.) The units may be composed of other units (as chapters are made out of paragraphs) and may be combined to form larger units (as chapters make up a book).

It is important to note that we may discard conventional document boundaries without discarding the notion of unit organization; organized units of text need not have linear sequence, as they do usually. Moreover, organizing text into units need not restrict the types of interconnection among these units that may be tried. We may indeed define unit boundaries in hypertexts, to give creators and users a sense of orientation, and to facilitate administration.

B. TEXT TYPES

Let us then consider different types of texts. Acknowledging that this taxonomy is quite tentative and uncertain, I will try to enumerate some characteristics that texts of all kinds can have. The object is to learn what traits will distinguish the different kinds of text (especially, hypertext) from one another.

Collection vs. Composition. We may distinguish text structures according to the way in which their units are created. We may distinguish between *collected* texts, which are assembled by some method or rule, and *composed* texts, which are put together with consideration of some of their overall properties by some human agency. As examples of collected text we may take a full mail box, a library, or an issue of *The New York Times;* as examples of composed texts we may consider most books or poems, or the front page of *The New York Times.*

Sequentiality. The next obvious distinction is that of sequentiality. The texts may be *sequential,* that is, have a specific order of presentation, or

structural, with the reader free to move among the parts as he sees fit. (Books as we know them are of both kinds, and there are mixed cases as well; again, the newspaper.)

Connective Structure. The connective relations of texts are yet another basis for distinguishing among them. There may be many different patterns of discrete connections among minimal text segments. Similarly, between the larger text units—which may contain many pieces—there may be many degrees of overlap, interconnectedness and penetration. Print technology has limited our experience of text interconnection, but there are simple conventional examples. These include parallel texts (commentaries, parodies) and hooked-on materials (the footnote, the illustration).

Hierarchical relations may also exist among text structures. That is, some units may be "over" others. By convention this hierarchical relation has to do with conceptual generality in the higher unit. However, hierarchy might take on other meanings. Even for the existing "generality" convention, lattice or other connective structures are possible, where the "more general" units could be for different contexts and settings.

The hypertext will have other attributes, based neither on units nor connectedness. These we may deem (depending on various things) to be "at the user interface," at the option of the text's creator, or left to the decisions inherent in an administrative setup. They include the user's freedom to read or use anything contained in the text complex; his ability to take notes, trace his wanderings, or otherwise to couple the use of the hypertext with his own library system; and permission to contribute to the text.

The supporting facility that presents the hypertext must also have—besides displays and calls, indexing, and the ability to cross-follow from one part to another—such other functions as word searches and counts. (However, note that the provision of service functions that speed up look-ups and cross-referencing should not be confused with the hypertext medium.) It may also usefully include such complex indexing and queriable information structures as are now associated with DR and CR, just as books now contain indexes.

SUPPLANTING IR WITH HYPERTEXT

The problem is to answer questions and update specialists; that is, to facilitate specialist access and muster of information (SAMI).

Let us consider here a particular text structure for SAMI purposes, the specialist (or scholarship) hypertext. Let me offer speculations about what the specialist hypertext will be like.

The hypertext for these purposes will probably be a particular kind of

anthology. It will be a repository hypertext, continually enlarged and intermittently edited. Its constituent materials will be from time to time assembled into composed units; for instance, a collection of source texts in a given area of discourse. This collection will be connected with many links to specially-composed review articles, arranged in various strata of summary, detail and commentary. By reading in one of these master texts, and turning to original materials or other instructional sections, the user may keep abreast of a field or instruct himself in an unfamiliar area.

The creation and maintenance of these specialist hypertexts will be a cyclical process. First the "original" units or documents will be put in; these will correspond to reports and articles as they are now conventionally published. So assembled, they will constitute a collected hypertext, structured only by minor indexing—cross-referenced, say, by chronology, authorship and topic. These source materials will remain in the system.

From time to time these source materials will be assembled into composed units; without, however, losing anything in structure or independence, since they will continue to be separately addressable. The new composed units will be created by author-editors, like anthologies and review articles. These author-editors will write overviews, summaries and other passages of their own, create connections, make excerpts and digest versions, and add clarifications, arguments, comparisons, diagrams and miscellany.

The units will be signed, like review articles, and thus linked to the professional prestige of their authors. Short squibs and even connective relations may be attributable in this way to particular persons. The authorship will consist of both writing new material and making connections and arrangements among parts of what existed before. It follows that readers who know something may *contribute* materials. This requires an appropriate administrative context. Some people might need to have their work reviewed, others not.

Such a corpus will have new research results, discussion, and interjections continually added to it by identified individuals. It will be continually enlarged, restructured, reconstructed. Periodically the overview-articles will be updated or replaced, with the old ones kept available for the record. Materials of fading interest will not be destroyed; it will just take longer to get to them, and the newcomer will hear of them less.

Dissents may be incorporated. The system imposes no assumption of completeness or infallibility on its constituent parts. Inconsistencies will be welcome; and with all sides of any argument immediately available, the totality of interrelations among divergent viewpoints will be sooner understood.

Such an approach reflects the real structure of scientific and academic

fields. The text network of current interest will grow and change, rather than, in its fixity, depreciating in relevance as a remembrance of the way thinking went at a particular time.

REMARKS

Curiously, the common view of the information system appears to take it for granted that mechanization will mean depersonalization. "Naturally, such a machine will not be popular among authors since by and large no reference will be made to the originator of any given idea. But, on the other hand, perhaps this will be all to the good since it will avoid the hard feelings which are so often produced at the present time by inadequate referencing."[7] There is no need for such dehumanizing; it will work better the other way. The hypertext approach ties in with existing human institutions and motivations. We must discard the idea that efficient mechanization means arbitrary truncation.

It may be complained that we should eliminate the vagaries and biases that individuals composing hypertexts will introduce. To this I would reply that vagaries and biases which are signed by individuals, and for which they are responsible, are far preferable to those that are silently designed right into the system's heart.

To be useful, the hypertext medium requires some degree of prose discursiveness in the material, or variety in the ways and sequences that the same material can be connected together or explained. Indeed, these texts may be made big and diverse enough for study by specialist and beginner alike, with many entrances, tracks and specially-oriented meanders. Thus the user's previous background and level of knowledge could be taken beneficially into account by the author-editors.

It might be claimed that facilities of such a general character are not necessary for the purposes conventionally served by information retrieval. The purpose of retrieval systems is to inform the technical user of what he needs to know, giving short replies to discrete specific questions.

This may sometimes be the case. When technical queries seek only to fill the blanks in some known context, DR or CR will do. Often the user has all the background he needs, and no long explanation is needed as an explanatory frame for the short reply. But even the specialist cannot always ask specific questions or understand short answers, let alone cryptic titles and summaries of borderline literature. For such needs these systems really ought to be ready to teach in the larger sense, even when talking to professionals. SAMI systems need the backup capacity for general instruction or review. And so the function of the hypertext, even in the SAMI context,

will be somewhere between "teaching" and "giving information." (How often there seems no feasible practical distinction between these two.)

Such systems will not, of course, replace all information retrieval systems. Where a fixed-context retrieval structure safely tells the user all he needs to know, as does a train schedule, nothing further is required.

UNDERSTANDING THE MEDIUM

Computer branching operations, text storage and display determine this medium. If this is the case, why is the medium taking so long to be developed? I claim that our problem has been not knowing, in some important sense, what the things are *for*, even though these devices have been with us for some fifteen years.

If complex text display and handling is (or determines) a medium, why doesn't everybody know it?

There are two answers to this, which complement each other.

The first is that various people *do* know it, *have* grasped the medium's character. The second is that there is no reason to expect everybody to catch on to a new medium right away. Let me discuss both of these assertions.

To predict that we will have non-linear text media is not very original. Similar ideas have been expressed by many people, beginning with Vannevar Bush,[8] if we do not mention the Oz books and other immemorial sources. Marshall McLuhan has said it in a very general way: this "mosaic" medium is another step in the transition to organic thinking, learning and society that he predicts.[9] The suggestion here encompasses views expressed by Harold Wooster,[10] H. Bohnert and M. Kochen,[11] T. M. Williams,[12] and (in different places) by several contributors to the Intrex Planning Conference.[13] Bush's prediction was the most thorough. But someone identified only as "Our Special Correspondent" also made the point rather precisely in the *Times Literary Supplement*, May 4, 1962, when he (?) said the scholar of the future would "do more than simply manage linear prose. . . ." Rather, he would "cut it like a film or compose it like a picture. . . ."[14]

CULTURAL LAG

Sociologically, we may regard information retrieval (DR,CR) as a somewhat conservative response by the professional community to various technological innovations. It is a time-honored sociological theory (advocated chiefly by W. F. Ogburn[15]) that practices take time to catch up to inventions. This is called "cultural lag," the delay between a change in society (especially a technological change) and the culture's catching up by squar-

ing related practices with the change. Confusion and inefficiency follow the change until the society finds appropriate ways to deal with it.

For reasons both personal and corporate, the irruption of technology in information handling could not be ignored. It had to be assimilated. "Information retrieval" continued the things that had been done before, extending the indexing and abstraction processes. Document retrieval is an advanced card file; queriable information networks are advanced reference charts.

THE MOTION PICTURE ANALOGY

I would like to draw an analogy between hypertext and the motion picture. By considering the time and trouble it recently took to understand the nature of the motion picture—another prepared temporal and visual medium—we may see better why things are difficult now.

Motion pictures are of interest to us in several contexts; in the development of their elements and techniques; in the development of organized units, especially units which are effective and viable; and in the development of the signatory property, the ability to be signed. These comparisons are suggestive analogies rather than close parallels. Let me recite some highlights from the history of motion pictures, so that the sorts of development that occurred, and what was on the minds of its developers, can enlighten our present. (This will concentrate on the photoplay; let it be understood that other uses of the film are derivative.)

The technology of the motion picture was not suddenly created in the shop of any one inventor. However, Edison's invention, first tried with film in 1889, was the one that took. He called it the kinematograph. It permitted fast viewing of successive frames on a long strip of film. Edison did not work on a projector because he and his advisors thought it would destroy the novelty. He also failed to patent his machine abroad. In 1895 Thomas Armat made a working projector for Edison's film. About the same time, the brothers Lumière, photographic manufacturers in France, created an all-purpose movie machine: the Cinématographe, which could be used by turns as camera, printer and projector. They promptly took it on the road as a novelty, showing films of local scenes, the arrival of trains, and the marching of troops.

The next year, 1896, a real showman began making movies in France. His name was Georges Méliès. A magician and theater operator, he at once saw the potentiality of the medium for presenting the astonishing and fantastic. He made many science-fiction and magic shorts. Méliès originated fades, dissolves, animation, and the whole range of trick photography and multiple exposures. He is also credited with the invention of editing. With *Cinderella* in 1900 Méliès is said to have produced the first story film.[18]

Meanwhile, films in America were already popular, having been introduced to vaudeville in 1896. Credit for being the first "theatrical film" is usually given to Edwin S. Porter's *The Great Train Robbery* (1903). However, Porter's *The Life of an American Fireman*, produced the year before, had contained all the same elements.

A curious monopoly circumstance, with interesting consequences, gradually came about in the American motion picture industry. Because various companies had tried to circumvent the Edison movie patents, there were many lawsuits over the process around the turn of the century. The legal tangle was cleared up by embracing the contending film companies into a monopoly. This monopoly, the General Film Trust, controlled all film production and distribution in America under the umbrella of the Edison patents. For a brief time (1909 to 1915) this trust produced films like sausages, undifferentiated, with the names of the makers and actors not revealed. The officers of this trust preferred that the works they produced be marketable as an interchangeable commodity of a single length (one reel) and quality (mediocre).

D. W. Griffith, the founder of the motion picture art and perhaps the greatest film director of all time, began directing anonymously during this period. In his early work with the Biograph Company, beginning in 1908, he experimented in every possible way with the construction of scenes and narratives, and soon surpassed every other director. Between 1908 and 1915 he invented and consolidated modern camera technique, modern editing technique, and modern narrative technique. By the end of this period his name was known. It was he that consciously began constructing the film out of *shots* rather than "scenes." Griffith's *The Birth of a Nation*, released in 1915, was a "total" film the way none had ever been. Uniting all the techniques that had come before, all his new effects of camera placement, cross-cutting, and tempo of movement and editing, he wove history, battles and love story into a single, entire fabric. Audiences were stupefied. Woodrow Wilson and Lenin were both deeply moved by the film.

Thus the twenty years from 1895 (Armat and Lumière machines) to 1915 (*The Birth of a Nation*) saw the development of a complete medium, in its scope, techniques, and units. No one caught onto it overnight. Nobody saw at the outset what it was going to become.

Now let us examine selected aspects of this brief history. The correspondences to the present situation may be evident.

A. THE MEDIUM'S MISUNDERSTOOD CHARACTER

If we consider the way some of the early things were done, it is by no means obvious that people working in the film at that time had the faintest idea of what was to come. Indeed, it seems that at least some of the film's originators did not know what they were doing or had done. Edison did not want to develop a projection system for his Kinematograph because he thought the novelty would wear off. And when Méliès asked to buy the Cinématographe, Auguste Lumière told him: "It can be exploited for a certain time as a scientific curiosity, but, apart from that, it has no commercial future whatsoever."[17]

Through a misunderstanding of the medium, and a failure to recognize its character, film-makers repeatedly imported to it the techniques of the stage. While stage *content*, when adapted, has worked, stage techniques have not worked in films, and have given satisfaction only for short periods of time.

The use of flat backdrops, action in a plane facing the camera, and the continuous take throughout a whole scene were all early conventions abstracted from the stage. The dramatic scene of early films was called the "action tableau," but it had relatively little action; its flat arrangement was a simple transposition from the stage, and its slight motion a prudent simplification of ordinary staging. This was the technique of Méliès, who also used painted backdrops shamelessly. Though the action tableaux, after Porter, became infused with more and more action, heavy stage influence remained. Even Porter was not completely won over by his own inventions. Though he had pioneered three-dimensional action and stirring visual effects in *The Great Train Robbery*, when he filmed *Uncle Tom's Cabin* he reverted to tableaux, flat sets and flat action.[18]

Stage plays have often been filmed as is; this occasionally happens even in the present day. It does not work very well. In 1907 the Film d'Art Company, in France, was established to uplift the motion picture by filming plays. Their product, while hailed for being cultured, was not very good. In 1912 Adolph Zukor's *Queen Elizabeth* opened. It was an attempt to immortalize Sarah Bernhardt on film. It made money. It also showed rather clearly that the sorts of posture, makeup, movement and declamatory style thought appropriate for the stage were not at home in the new medium.

But Griffith clearly saw the differences between stage and film. He was asked whether he thought knowledge of the stage was necessary to direct films. He said,

"No, I do not . . . The stage is a development of centuries, based on certain fixed conditions and within prescribed limits. It is needless to point out what these are. The moving picture, although a growth of only a few years, is boundless in its scope and endless in its possibilities. . . . The conditions equally dissimilar. . . ."[19]

B. TECHNIQUES

There is a basic roster of techniques of film. These are effects (stop-motion, animation), display arrangements (camera angles and movement), and the selection and interconnection of parts (direction, editing).

These techniques of film are basic and perfectly known to those who make films, though there is disagreement on style and appropriateness. All the techniques are familiar. Nothing is new, in the sense that it is impossible today to create new elements. There has been virtually nothing new in the last 50 (fifty!) years, since, say, Griffith's *Intolerance* (1916).* But these techniques of film were by no means obvious. It took twenty years of film-making to discover them, from 1895 to 1915. Though many of the films have been lost, in principle each innovation has associated with it a specific film, director and date. The various techniques were introduced one by one, chiefly by Méliès, Porter and Griffith.

Early movie-makers did not use more than one shot in a scene. They did not move the camera. They instructed their actors to wave their hands around and exaggerate every gesture, since the camera was so far away. And the camera was so far away because film-makers thought it looked wrong not to show the actor's whole body. Other rules included:

"1. Every scene must begin with an entrance and end with an exit, just as on the stage.

"2. Players must face the camera and move horizontally, except when the movement was rapid, as in a chase, or prolonged, as in a fight. At these times action was in diagonal relation to the camera in order to give the players more area.

"3. Any action in the background must be slow and greatly exaggerated so that it would 'register' on the audience.

"4. Pantomime must be exaggerated and over-deliberate; e.g., a stare had to be held; a start must be violent; speeches must be mouthed with pronounced slowness."[20]

C. UNITS AND THEIR ORGANIZATION

The character of basic units, in particular the narrative film, was not at

*Sound, color, etc., did not modify these techniques; but they added separate problems of their own and additional opportunities for synthesis.

first grasped. "In 1896, a special outdoor performance by Joseph Jefferson of *Rip Van Winkle* amidst the natural scenery of his summer home on Buzzard's Bay, Massachusetts, was recorded by Biograph on 219 feet of film. But instead of shooting this subject with a view toward an interesting and a dramatic continuity, it was filmed in eight episodes billed and sold as separate catalogue numbers. . . ."[21]

For a while, projected films were timed to the vaudeville turn, and then to the organization and taste of the nickelodeon theater. Though films tended naturally to become longer, after about 1908 The General Film Trust held the length of all Trust films to one reel (1000 feet, about sixteen minutes). It was not until the decline of the Trust that the American film could break out of this one-reel mold and attain feature length.

Not only was the overall unit misunderstood; the parts themselves were not thought to be manipulable and discrete. The basic unit was thought to be the "scene." It was only D. W. Griffith who learned to work in terms of *shots* rather than complete scenes; and to construct the scenes from the ground up, using the shot as the building block. Griffith discarded the principle that a scene must end before a new shot may begin, and, indeed, the principle that one scene must end before another begin.[22] By manipulating the constituent parts he learned to handle the motion picture as a whole, controlling and integrating all its aspects.

The climax, of course, was Griffith's *The Birth of a Nation*. Though panoramic spectacle with three-dimensional sets had been used before, especially in the Italian *Quo Vadis*, it had not previously been integrated with a well-told story. *The Birth of a Nation* was such a complete, unified, spectacular achievement: the true feature film, and a model seldom equalled.

D. THE SIGNATORY PRINCIPLE

"Films are made by men, not machines or corporations."[23] Yet interestingly enough, the notion that films should be *signed*—that is, have personal credit go to their creators—was not acknowledged for a time. Quite the contrary, credit was for a time *suppressed*.

The film trust's management of the motion picture industry from 1909 to 1915 produced an even stream of one-reel films whose actors and directors were not known to the public. The public was developing favorites, and demanding their names—like that of the girl everyone knew as "Little Mary." The exhibitors, too, wanted the names so they could in some measure control public response, i.e., book the favorites and advertise. But the favorites' names were kept a secret. (The film trust's policy of not releasing the names of actors was ably met abroad by the simple expedient of assigning names to them.[24])

The cat got out of the bag in 1910. Carl Laemmle of the trust-defying Imp Company publicly advertised the name of a film actress for the first time, after he had stolen her from a trust studio. Thus began the star system. Competition from Laemmle and other outlaw producers forced the trust companies to reveal names. ("Little Mary" found it expedient to adopt the name of Mary Pickford.) Griffith's name was first advertised when Biograph gave in to the new open-names policy in 1913.[25]

IMMANENCE

I have attempted to point out some curious similarites between a general-purpose medium we all know and a general-purpose medium that none of us, to my knowledge, has seen.

The comparison would be strongest, of course, if we based it on a premise of structural determinism. This would be to assert that media like the hypertext and film derive their character from intrinsic principles and internal dynamics that are somehow built right into them.

This was the view held by Kuleshov, the great Russian teacher of film. He said: "In every art there must be first a material, and secondly, a method of composing this material specially adapted to this art."[26] As the reader sees, it took several decades to discover these for the film.

Perhaps in general we have no leeway, then, and media are ours merely to discover rather than to invent. But I am not sure that for the hypertext it is this tight. We can in hypertexts establish precedents and traditions, doctrines and schools; we can, by stress upon programmed instruction, flash card effects or civil liberties, influence for worse or better its usefulness to our society and condition.

The medium has an internal dynamic, I think, immanent and intrinsic in the technology. This we must discover. But however compelling this internal dynamic may be, there will be play for some adjustments. We must strive to add the touches that suit it best to the way we want to do things.

A DISANALOGY: STANDARDIZATION

By luck, movies are standard. The width and sprocketing of Edison's original films became and remained the 35mm motion picture standard. While there are other standards for other purposes (8mm, 16mm) and other rival processes (3-D, introduced in 1922, and such other intermit-

specials as wide-screen and smell track), in general, a movie is a

order to try out the new medium, other than haphazardly, standard- things must be created, so that work in this medium can be used and around. We need standardized character-sets and connector notation, and ways of scaling down a presentation to a sparse facility and of ing it through varying screens, buffers and accessories. This might complished by the specification of standard facility levels, so the s of such things could either stipulate a minimum system required of a given text, or an appropriate presentation level for each con- tion of hardware.

over, it will be necessary to establish reliable royalty provisions thors, editors and contributors, probably based on the presentation . But something equivalent to *ownership of a copy* will also be neces- so that a given user may have unlimited access to his own possessed rial.

CLUSION

formation retrieval has extended traditional techniques to new tech- gy. An analogy has been found in the history of motion pictures. The techniques of the theater were at first extended to movies, and it was al decades before we understood the motion picture as a medium. It s natural to extrapolate these prior techniques to the movie as it now s natural to extrapolate prior techniques of information handling to RT-computer-mass memory system. Here again, as in films, the tech- gy makes possible a medium which is radically new and has dynamics own. The most suitable techniques and units were not immediately at in movies, either.

e conventional "document" is not God-given, and in fact is inappro- for most purposes. Systems based on discrete and isolated documents pish the greatest power of the new technology. But at the other me we are wrong to suppose that an information machine can or ld eliminate the human task of composition. We have not begun to re the possibilities of natural language woven into more complex (but natural) arrangements.

e problem of Getting It Out of Our System, then, is not the problem

is important to note that facilities are readily available for the transposition of andard work to the main standard, by optical printing and sound transfer. Often ty effects offered in first-run theaters are scaled down to the standard for ution.

of fishbook design for a document pool, or of creating a conversational black box with a narrow vocabulary. We must get out of our system the fixities of thinking and procedure that hold us back.

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